

WORK IT OUT

A maths workbook — concepts, worked examples, graded practice and number puzzles

Do the Learn First pages before the practice. Do the practice before the puzzles. Full solutions are at the back — but they only help you after you have tried.

Part	What it is	How to use it	Time
1	Learn First	Read and annotate. Copy every worked example by hand.	25 min
2	Worked Examples	Cover the solution. Try. Then compare line by line.	20 min
3	Guided Practice	Steps are given; you fill the gaps.	15 min
4	Practice Set A • Fluency	Straight application. Aim for speed and accuracy.	20 min
5	Practice Set B • Reasoning	Multi-step. Show every line.	25 min
6	Practice Set C • Challenge	Stretch problems. One may beat you — that is fine.	25 min
7	The Crossnumber	Answers are numbers. Wrong maths will not fit.	20 min
8	Number Search & Magic Square	Solo or pairs.	15 min
9	Spot the Mistake	Audit a worked solution. Find the planted error.	15 min
10	Quick-Fire Round	Matching, True/False, Two Truths and a Lie.	15 min
11	The Escape Challenge	Teams of 4.	25 min

Part 1 • Learn First

Every time you toss a coin, roll a die, or draw a card, you are running an experiment whose result you cannot know in advance — but whose long-run pattern you can measure exactly. That measurement is called probability.

Randomness and the probability scale

A **random experiment** (or trial) is something you can repeat — like tossing a coin or rolling a die — where the result may differ every time and cannot be known in advance, even though every possible result is known.

Outcome. A single result of an experiment (e.g. getting Heads).

Sample space. The set of *all* possible outcomes of an experiment, written inside curly brackets. For a coin toss the sample space is $\{H, T\}$; for a standard die it is $\{1, 2, 3, 4, 5, 6\}$.

Event. One or more outcomes we are interested in (e.g. "rolling an even number" is the event $\{2, 4, 6\}$).

Probability is measured on a scale from 0 to 1 (or 0% to 100%). A probability of 0 means the event is **impossible**; a probability of 1 means it is **certain**. Most real events sit strictly between the two, described as less likely, equally likely (even chance), or more likely.

Event	Probability	What it means
Getting a number greater than 6 on a die	0	Impossible
Rolling a 3 on a standard die	small (1/6)	Less likely
Flipping a coin and getting Heads	0.5	Even chance
Drawing a number 2-10 from a 52-card deck	36/52 (large)	More likely
Choosing a red sweet from a bag of all red sweets	1	Certain

□ Rule to remember

- $0 \leq P(Event) \leq 1$ always.
- A coin and a die are assumed **fair (unbiased)** unless stated otherwise — symmetrical, with no reason to favour one outcome over another.
- A "random toss" or "random roll" means the object is allowed to fall or settle freely, with no interference.

Experimental probability — measuring from data

Sometimes we estimate probability by actually performing the experiment (or looking at recorded trials) and counting how often the event happened.

$$\text{Experimental Probability} = \frac{\text{Number of } \times \text{ the event occurred}}{\text{Total number of trials}}$$

This is also called the **relative frequency** of the event. It is built entirely from observed data, not from assumptions about fairness.

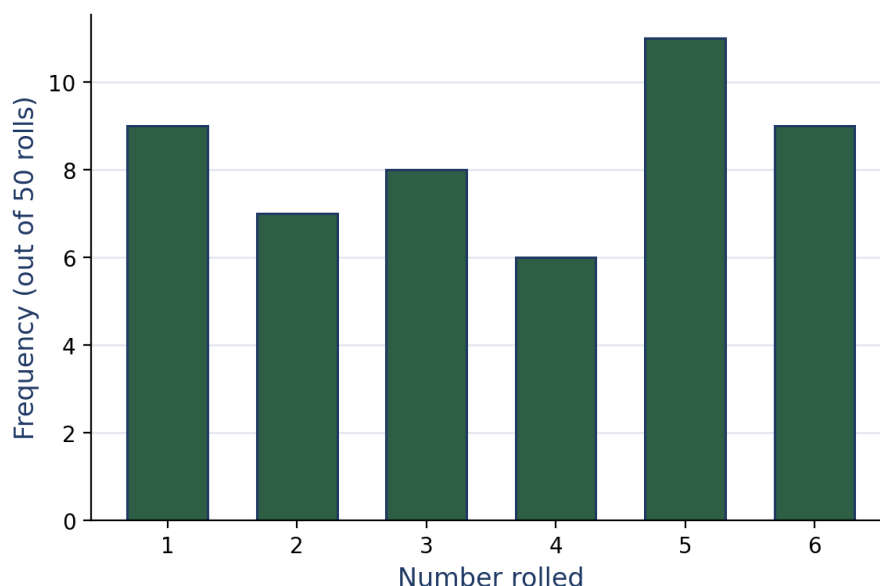


Fig. 7.A — results of 50 rolls of a die (bar chart of frequencies)

□ Rolling a die 50 times

Suppose a die is rolled 50 times and lands on 4 exactly 8 times.

Experimental probability of rolling a 4 $\hat{=}$ $\frac{8}{50} = 0.16$

As a percentage, that is 16%.

Note: this number comes purely from the 50 trials recorded — a different 50 rolls could give a slightly different value.

Theoretical probability — reasoning without an experiment

When every outcome is equally likely (a perfectly fair situation), we can calculate probability directly by reasoning, with no data collection needed.

$$\textit{Theoretical Probability } P(\textit{Event}) = \frac{\textit{Number of favourable outcomes}}{\textit{Number of possible outcomes}}$$

"Favourable outcomes" means the outcomes that make the event happen; "possible outcomes" means everything in the sample space.

□ Worked micro-example — letters of a word

- A letter is picked at random from the word PROBABILITY (11 letters, with the letter B appearing twice).
- $P(\textit{letter B}) = \frac{2}{11} \approx 0.182$ or 18.2%.

□ Rolling a 4 on a fair die

What is the theoretical probability of rolling a 4 on a standard die?

Favourable outcomes = 1 (only the face showing 4).

Possible outcomes = 6 (the sample space $\{1, 2, 3, 4, 5, 6\}$).

$$P(\textit{rolling a 4}) = \frac{1}{6} \approx 0.167 \text{ or } 16.7\%.$$

Statistical (survey) probability, and comparing the three methods

A third, closely related idea: estimating probability from a **sample survey** of a larger population.

Fifty students are asked their favourite fruit: 20 say mango, 15 apple, 10 banana, 5 grape.

$$P(\text{mango}) = \frac{20}{50} = 0.4$$

If the whole school has 1500 students, we can **estimate** that about $0.4 \times 1500 = 600$ students prefer mango — the sample result is scaled up to the population. Bigger, fairer samples give more reliable estimates; this is called **sampling**.

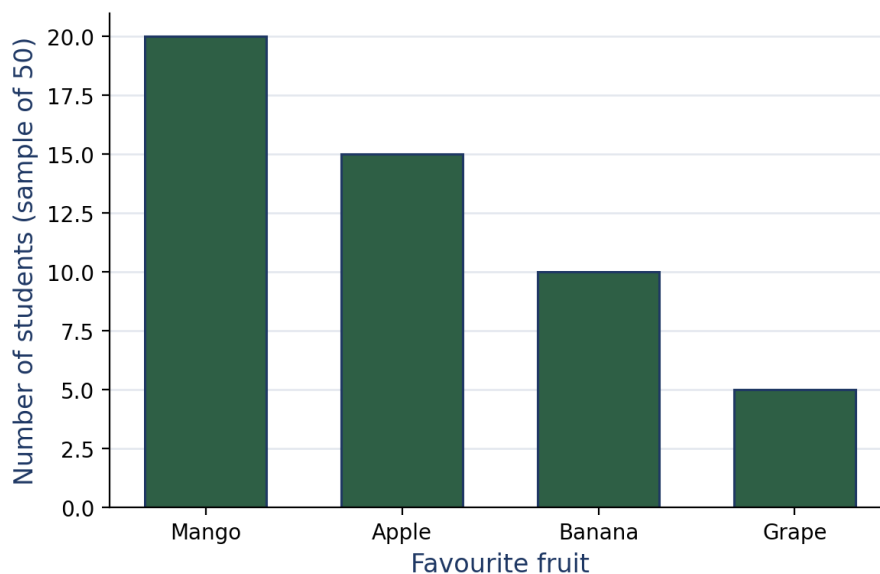


Fig. 7.B — favourite fruit of a sample of 50 students

□ Law of Large Numbers, and the Gambler's Fallacy

- **Law of Large Numbers:** as the number of trials increases, experimental probability tends to get closer and closer to theoretical probability.
- **Gambler's Fallacy** is the mistaken belief that past random results affect future ones — e.g. thinking that after six Heads in a row, Tails is "due". A fair coin has **no memory**: $P(\text{Tails})$ is still $\frac{1}{2}$ on the very next toss.
- Each roll of a die or toss of a coin is an **independent event** — the probability of the next result never changes because of what happened before.

Part 2 • Worked Examples

Cover the right-hand column with a sheet of paper. Try the problem yourself first. Then uncover it one line at a time and check where your reasoning parted from the model.

Example 1 — A bag has 4 red, 3 blue and 5 green marbles. Find the theoretical probability of drawing a blue marble.

Step 1. Find the total number of possible outcomes (total marbles): $4+3+5=12$.

Step 2. Find the number of favourable outcomes (blue marbles): 3.

Step 3. Apply the formula. $P(\text{blue}) = \frac{\text{favourable}}{\text{possible}} = \frac{3}{12} = \frac{1}{4}$.

Answer: $P(\text{blue}) = \frac{1}{4} = 0.25$ or 25%.

□ Why this works

The formula only needs two counts — favourable and total — and both come straight from listing the sample space. No experiment was needed because every marble is equally likely to be picked.

Example 2 — A coin is tossed 40 times. It lands Heads 18 times. Find the experimental probability of Heads, and compare it with the theoretical probability.

Step 1. Count the trials where the event (Heads) occurred: 18.

Step 2. Count the total number of trials: 40.

Step 3. Experimental probability $\hat{P}(\text{Heads}) = \frac{18}{40} = 0.45$.

Step 4. Theoretical probability of Heads for a fair coin $\hat{P}(\text{Heads}) = \frac{1}{2} = 0.5$.

Answer: Experimental probability (0.45) is close to but not exactly equal to theoretical probability (0.5) — expected, since 40 trials is a fairly small sample.

□ Why this works

By the Law of Large Numbers, more tosses would push the experimental value closer to 0.5. The gap here is ordinary sampling variation, not evidence the coin is unfair.

Example 3 — A spinner has 8 equal sectors numbered 1 to 8. Find $P(\text{spinner lands on a number greater than 5})$.

Step 1. List the sample space: $\{1, 2, 3, 4, 5, 6, 7, 8\}$ — 8 possible outcomes.

Step 2. List the favourable outcomes (numbers greater than 5): $\{6, 7, 8\}$ — 3 outcomes.

Step 3. $P(\text{>5}) = \frac{3}{8}$.

Answer: $P(\text{>5}) = \frac{3}{8} = 0.375$ or 37.5%.

□ Why this works

Writing out the sample space first prevents the most common error in this topic — miscounting how many outcomes actually satisfy the event.

Part 3 • Guided Practice

The method is laid out for you. Fill in the blanks. If you can do these without looking back at Part 2, you are ready for Part 4.

1. A die is rolled once. Find $P(\text{rolling an even number})$.

Sample space: $\{1, 2, 3, 4, 5, 6\}$ — total possible outcomes = _____.

Favourable outcomes (even numbers): $\{2, 4, 6\}$ — count = _____.

$$P(\text{even}) = \frac{\text{favourable outcomes}}{\text{total possible outcomes}} = \frac{3}{6} = \frac{1}{2}.$$

2. A card is drawn at random from the word "MATHEMATICS". Find $P(\text{drawing the letter M})$.

Total letters in MATHEMATICS = _____.

Number of times M appears = _____.

$$P(M) = \frac{\text{number of M's}}{\text{total letters}} = \frac{2}{11} \quad (\text{as a fraction in lowest terms}).$$

3. A bag has 50 tickets numbered 1–50. Find $P(\text{the ticket drawn is a multiple of 5})$.

List the favourable outcomes: 5, 10, 15, ..., _____.

Count of favourable outcomes = _____.

$$P(\text{multiple of 5}) = \frac{\text{count of favourable outcomes}}{50} = \frac{10}{50} = \frac{1}{5}.$$

4. A spinner is spun 60 times and lands on red 21 times. Find the experimental probability of red, and state whether this looks close to a theoretical probability of $\frac{1}{4}$.

$$\text{Experimental probability of red} = \frac{21}{60} = \frac{7}{20} = 0.35 \quad (\text{as a decimal}).$$

Theoretical probability of $\frac{1}{4}$ as a decimal = _____.

Compare: the experimental value is _____ (close to / far from) the theoretical value.

Practice Set A • Fluency

Straight application of the method. Aim to get every one right, then aim to get them right quickly.

#	Question	Your working and answer
1	A coin is tossed once. Write the sample space.	
2	A die is rolled once. Find $P(\text{rolling a } 5)$.	
3	A die is rolled once. Find $P(\text{rolling a number less than } 3)$.	
4	A bag has 3 red and 7 white balls. Find $P(\text{drawing a red ball})$.	
5	A letter is chosen at random from the word "PROBABILITY". Find $P(\text{choosing the letter I})$.	
6	A spinner has sectors numbered 1 to 10. Find $P(\text{landing on an odd number})$.	
7	In 25 tosses of a coin, Heads appeared 14 times. Find the experimental probability of Heads.	
8	A die is rolled 60 times and shows a 6 exactly 12 times. Find the experimental probability of rolling a 6.	
9	A survey of 40 people found 25 prefer tea over coffee. Estimate $P(\text{a random person prefers tea})$.	
10	State whether each probability is possible: (i) 0.5 (ii) 1.2 (iii) 0 (iv) -0.3	

Practice Set B · Reasoning

Two or more steps, or a step you have to choose for yourself. Show every line — marks live in the working.

#	Question	Your working and answer
1	A box has 5 blue, 4 green and 6 yellow pens. Find $P(\text{drawing a pen that is not yellow})$.	
2	A die is rolled once. Find $P(\text{getting a number that is a multiple of 3})$.	
3	Two events for a die: $A = \text{"rolling a prime number"}$, $B = \text{"rolling a number greater than 4"}$. List both events as sets and find $P(A)$ and $P(B)$.	
4	A coin is tossed 100 times, giving 46 Heads and 54 Tails. Find the experimental probability of each outcome, and comment on how close they are to 0.5.	
5	A bag has 50 tickets numbered 1 to 50. Find $P(\text{the number is a perfect square})$.	
6	In a class of 30 students, a survey shows 12 like cricket, 10 like football and 8 like badminton. Estimate how many of 900 students in the whole school are likely to prefer football, using the sample proportion.	
7	A spinner has 8 equal sectors coloured: 3 red, 2 blue, 3 green. Find $P(\text{not red})$.	
8	Explain, using the coin-toss idea, why the Gambler's Fallacy is a mistaken belief. Include a numerical example.	

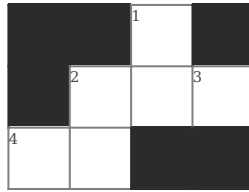
Practice Set C • Challenge

Harder, and deliberately so. If one defeats you, write down exactly where you got stuck. That sentence is worth more than a copied answer.

#	Question	Your working and answer
1	A die is rolled and a coin is tossed together. List the full sample space of combined outcomes, and find the probability of getting an even number on the die AND Heads on the coin.	
2	A bag contains only red and blue balls. The probability of drawing a red ball is $\frac{2}{5}$. If there are 8 red balls, find the total number of balls in the bag.	
3	A survey of 60 randomly chosen households found that 45 own a bicycle. If a town has 18,000 households, estimate how many bicycles are owned, stating any assumption you make.	
4	A fair die is rolled 300 times. Based on theoretical probability, how many times would you <i>expect</i> to roll a 4? If it actually landed on 4 only 38 times, is this unusual? Explain using the Law of Large Numbers.	
5	Two friends disagree: one says "a coin that has landed Heads 5 times running must land Tails next", the other disagrees. Who is correct, and why? Support your answer with the exact probability value.	

Part 7 • The Crossnumber

Every answer is a number. One digit per square. Because answers cross, a wrong calculation simply will not fit — this puzzle marks itself.



ACROSS

1. Number of outcomes in the sample space of a coin toss (1 digits)
2. Percent value of a certain event (3 digits)
4. Number of tickets in a bag numbered 1 to 50 (2 digits)

DOWN

1. Number of students (of 50) who like mango best (2 digits)
2. Number of tickets that are multiples of 5, out of 50 (2 digits)
3. Probability value of an impossible event (1 digits)

Bonus questions that did not fit the grid — work them out anyway: Number of outcomes in the sample space of a standard die; Number of letters in the word PROBABILITY; Probability value of a certain event; Number of favourable outcomes for rolling an even number on a die; Combined outcomes when a die and a coin are used together (6 x 2)

Part 8 • Number Search & Magic Square

Work out each answer, then find it hidden in the digit grid — across, down, diagonally or backwards.

0	8	9	3	8	6	1	0	0	8	5	1
9	0	3	0	5	5	8	2	0	5	2	0
3	3	4	3	8	4	9	0	4	4	3	7
2	3	4	9	0	7	7	1	8	0	4	3
1	7	2	5	0	6	5	0	0	1	2	1
9	2	8	3	8	4	7	5	0	9	2	8
4	4	5	2	3	1	2	6	9	8	8	0
1	0	5	4	1	9	0	3	2	6	7	5
1	0	1	3	1	2	4	0	3	3	7	9
7	1	5	8	1	6	4	9	0	8	3	4
0	4	9	8	0	4	9	0	7	0	0	3
3	5	9	5	3	5	4	1	5	8	7	1

☐ 100	☐ 300	☐ 11	☐ 50	☐ 25
☐ 12	☐ 40	☐ 30	☐ 45	☐ 60
☐ 6	☐ 8			

Magic Square — every row, column and diagonal adds to the same total.

8		6
3	5	
	9	

Magic constant: 15. Fill the empty cells.

Part 9 • Spot the Mistake

Each solution below reaches a wrong answer, and exactly one step is to blame. Find the first wrong step and rewrite it correctly. Marking other people's work is the fastest way to stop making their mistakes.

□ Spot the Mistake

Finding P(rolling an even number) on a die

Step 1. Sample space is $\{1, 2, 3, 4, 5, 6\}$, so total outcomes = 6.

Step 2. Even numbers are $\{2, 4\}$, so favourable outcomes = 2.

Step 3. $P(\text{even}) = \frac{2}{6} = \frac{1}{3}$.

_____ The first wrong step is Step _____. What should it say?

□ Spot the Mistake

Computing experimental probability from 50 rolls, 8 of which were a 4

Step 1. Experimental probability $\hat{P} = \frac{\text{trials}}{\text{event count}} = \frac{50}{8}$.

Step 2. This simplifies to 6.25.

Step 3. A probability greater than 1 is impossible, so something is wrong here.

_____ The first wrong step is Step _____. What should it say?

□ Spot the Mistake

Reasoning about the Gambler's Fallacy after 3 sixes in a row

Step 1. The die has just shown a 6 on three consecutive rolls.

Step 2. Since a 6 has come up so often already, the next roll is now less likely to be a 6, maybe around $\frac{1}{12}$.

Step 3. So the player should bet against rolling a 6 on the next turn.

_____ The first wrong step is Step _____. What should it say?

Part 10 · Quick-Fire Round

Match each scenario to its probability

Draw a line from each item on the left to its match on the right.

#	Left	Right (shuffled)
1	Rolling a number greater than 6 on a standard die	1/5
2	Tossing a fair coin and getting Heads	1/6
3	Choosing a red sweet from a bag of only red sweets	0 (impossible)
4	Rolling a 4 on a standard die	1 (certain)
5	Drawing the letter B from PROBABILITY	1/2
6	Rolling an odd number on a standard die	1/2 (even chance)
7	Drawing a multiple of 5 from tickets 1-50	1 (certain)
8	Rolling a number less than 7 on a standard die	2/11

True or False Sprint

Everyone stands. Teacher reads a statement. True → stay standing. False → sit down.

#	Statement	Your call
1	Probability is always a number between 0 and 1, inclusive.	☐ True ☐ False
2	A probability of 0 means an event is certain to happen.	☐ True ☐ False
3	Experimental probability is calculated using $\frac{\text{event count}}{\text{total trials}}$.	☐ True ☐ False
4	Theoretical probability requires actually performing an experiment.	☐ True ☐ False
5	The sample space of a coin toss is $\{H, T\}$.	☐ True ☐ False
6	The sample space of a standard die is $\{1, 2, 3, 4, 5, 6, 7\}$.	☐ True ☐ False

#	Statement	Your call
7	As the number of trials increases, experimental probability tends to approach theoretical probability.	☐ True ☐ False
8	The Gambler's Fallacy is the correct way to predict future coin tosses.	☐ True ☐ False
9	Each toss of a fair coin is an independent event.	☐ True ☐ False
10	If $P(\text{event}) = 0.7$, then the event is more likely to happen than not.	☐ True ☐ False
11	Statistical (survey) probability is estimated using a sample and scaled to a population.	☐ True ☐ False
12	A probability can be greater than 1 if the event is very likely.	☐ True ☐ False

Two Truths and a Lie

Two statements are true, one is false. Circle the lie — then correct it.

Set 1

- (a) The sample space of a die roll has 6 outcomes.
- (b) Theoretical probability needs an experiment to be performed first.
- (c) Experimental probability is also called relative frequency.

The lie is _____. Corrected: _____

Set 2

- (a) A fair coin has no memory of past tosses.
- (b) After 5 Heads in a row, Tails becomes more likely on the next toss.
- (c) $P(\text{Heads})$ on a fair coin is always $1/2$, regardless of past results.

The lie is _____. Corrected: _____

Set 3

- (a) Probability can never be negative.
- (b) A probability of exactly 1 means the event is certain.
- (c) A probability of 0.5 means the event will happen exactly half the times you try it.

The lie is _____. Corrected: _____

Part 11 · The Escape Challenge

Five gates, each a calculation. Each gives you one digit. Collect all five to unlock the exit code.

□ GATE 1 — The Sample Space Gate

How many outcomes are in the sample space of a standard die roll?

Digit: □

□ GATE 2 — The Coin Gate

A coin is tossed 20 times and lands Heads 9 times. What is the count of Heads (the numerator used in the experimental probability formula)?

Digit: □

□ GATE 3 — The Favourable Gate

How many favourable outcomes are there for rolling an even number on a standard die?

Digit: □

□ GATE 4 — The Word Gate

How many letters are in the word PROBABILITY?

Digit: □

□ GATE 5 — The Percent Gate

If $P(\text{event}) = 1/4$, what is this as a whole-number percentage?

Digit: □

EXIT CODE: □ □ □ □ □

□ Formula Sheet

Cut this page out and keep it. Everything in this chapter, on one page.

Probability range

$$0 \leq P(Event) \leq 1$$

Experimental probability

$$\frac{\text{Number of } \times \text{ the event occurred}}{\text{Total number of trials}}$$

Theoretical probability

$$P(Event) = \frac{\text{Number of favourable outcomes}}{\text{Number of possible outcomes}}$$

Certain event

$$P(Event) = 1$$

Impossible event

$$P(Event) = 0$$

Estimating a population count

$$\text{Estimate} = P(Event) \times \text{Population} \text{ \textcolor{red}{!}!}$$

□ Full Solutions

Not just answers — working. Compare your method with this one; if they differ but both reach the right answer, make sure you understand why yours also works.

Part 3 • Guided Practice

1. 6 total; {2,4,6}, count 3; $P = 3/6 = 1/2$ · 2. 11 letters; M appears 2 times; $P = 2/11$ · 3. 50; count 10; $P = 10/50 = 1/5$ · 4. $21/60 = 0.35$; $1/4 = 0.25$; 0.35 is somewhat far from 0.25 — not very close

Practice Set A

1. $\{H, T\}$.

2. $P(5) = \frac{1}{6}$.

3. Numbers less than 3: $\{1, 2\}$, so $P = \frac{2}{6} = \frac{1}{3}$.

4. Total balls $\textcolor{red}{3} + 7 = 10$; $P(\textcolor{red}{3}) = \frac{3}{10}$.

5. PROBABILITY has 11 letters, with 1 I; $P(I) = \frac{1}{11}$.

6. Odd numbers 1,3,5,7,9 — 5 of 10; $P(\text{odd}) = \frac{5}{10} = \frac{1}{2}$.

7. $P(\text{Heads}) = \frac{14}{25} = 0.56$.

8. $P(6) = \frac{12}{60} = 0.2$.

9. $P(\text{tea}) = \frac{25}{40} = 0.625$.

10. (i) possible (ii) not possible — exceeds 1 (iii) possible — impossible event (iv) not possible — negative.

Practice Set B

1. Not-yellow pens $\textcolor{red}{5} + 4 = 9$ out of $5 + 4 + 6 = 15$; $P = \frac{9}{15} = \frac{3}{5}$.

2. Multiples of 3: $\{3, 6\}$ (out of $\{1 \dots 6\}$); $P = \frac{2}{6} = \frac{1}{3}$.

3. $A = \{2, 3, 5\}$, $P(A) = \frac{3}{6} = \frac{1}{2}$; $B = \{5, 6\}$, $P(B) = \frac{2}{6} = \frac{1}{3}$.

4. $P(H) = \frac{46}{100} = 0.46$, $P(T) = \frac{54}{100} = 0.54$ — both close to 0.5, as expected from the Law of Large Numbers with 100 trials.

5. Perfect squares from 1-50: 1,4,9,16,25,36,49 — 7 numbers; $P = \frac{7}{50}$.
6. Sample proportion for football $\hat{p} = \frac{10}{30} = \frac{1}{3}$; estimate $\hat{p} \times 900 = 300$ students.
7. Not red $\hat{p} = \frac{2+3}{5} = \frac{5}{8}$ of 8; $P(\text{not } \hat{p}) = \frac{5}{8}$.
8. Each toss is independent, so past results (e.g. several Heads in a row) do not change the next toss's probability: $P(\text{Heads}) = \frac{1}{2}$ every single time, never adjusted by history — believing otherwise is the Gambler's Fallacy.

Practice Set C

1. Combined sample space has $6 \times 2 = 12$ outcomes: (1,H)...(6,T). Even-and-Heads outcomes: (2,H),(4,H),(6,H) — 3 of 12, so $P = \frac{3}{12} = \frac{1}{4}$.
2. $P(\hat{p}) = \frac{8}{\text{total}} = \frac{2}{5}$, so total $\hat{p} \times 8 \times \frac{5}{2} = 20$ balls.
3. Sample proportion $\hat{p} = \frac{45}{60} = 0.75$; estimate $\hat{p} \times 18000 = 13500$ bicycles, assuming the sample of 60 households fairly represents the town.
4. Expected count $\hat{p} \times 300 = 50$. Getting only 38 is somewhat below expected but not extreme for a sample this size — random variation is normal; the Law of Large Numbers describes long-run behaviour over very many trials, not a guarantee for any fixed run.
5. The second friend is correct. A fair coin is memoryless — $P(\text{Tails}) = \frac{1}{2}$ on the very next toss regardless of the previous 5 outcomes. Believing otherwise is the Gambler's Fallacy.

Part 7 • Crossnumber — Solved Grid

			1	
			2	
	2		0	3
	1		0	
4	5	0		

Across: 1 = $2 \cdot 2 = 100 \cdot 4 = 50$

Down: 1 = $20 \cdot 2 = 10 \cdot 3 = 0$

Part 8 • Number Search — Solved Grid

0	8	9	3	8	6	1	0	0	8	5	1
---	---	---	---	---	---	---	---	---	---	---	---

9	0	3	0	5	5	8	2	0	5	2	0
3	3	4	3	8	4	9	0	4	4	3	7
2	3	4	9	0	7	7	1	8	0	4	3
1	7	2	5	0	6	5	0	0	1	2	1
9	2	8	3	8	4	7	5	0	9	2	8
4	4	5	2	3	1	2	6	9	8	8	0
1	0	5	4	1	9	0	3	2	6	7	5
1	0	1	3	1	2	4	0	3	3	7	9
7	1	5	8	1	6	4	9	0	8	3	4
0	4	9	8	0	4	9	0	7	0	0	3
3	5	9	5	3	5	4	1	5	8	7	1

Part 8 • Magic Square — Solved (constant 15)

8	1	6
3	5	7
4	9	2

Part 9 • Spot the Mistake

Problem	First wrong step	It should say
Finding $P(\text{rolling an even number})$ on a die	Step 1	The even numbers on a die are $\{2, 4, 6\}$ — 3 outcomes, not 2. So $P(\text{even}) = \frac{3}{6} = \frac{1}{2}$.
Computing experimental probability from 50 rolls, 8 of which were a 4	Step 3	The formula is $\frac{\text{number of } \times \text{ the event occurred}}{\text{total trials}} = \frac{8}{50} = 0.16$ — the numerator and denominator were swapped.

Problem	First wrong step	It should say
Reasoning about the Gambler's Fallacy after 3 sixes in a row	Step 1	Each roll is an independent event — the die has no memory. The probability of rolling a 6 next is still exactly $\frac{1}{6} \approx 0.166$, unchanged by past rolls.

Part 10 • Matching

#	Left	Correct match
1	Rolling a number greater than 6 on a standard die	0 (impossible)
2	Tossing a fair coin and getting Heads	1/2 (even chance)
3	Choosing a red sweet from a bag of only red sweets	1 (certain)
4	Rolling a 4 on a standard die	1/6
5	Drawing the letter B from PROBABILITY	2/11
6	Rolling an odd number on a standard die	1/2
7	Drawing a multiple of 5 from tickets 1-50	1/5
8	Rolling a number less than 7 on a standard die	1 (certain)

Part 10 • True or False

1-T • 2-F • 3-T • 4-F • 5-T • 6-F • 7-T • 8-F • 9-T • 10-T • 11-T • 12-F

Part 10 • Two Truths and a Lie

Set	The lie	Correction
1	b	Theoretical probability is calculated purely by reasoning about equally likely outcomes — no experiment is needed. That is what separates it from experimental probability.
2	b	This is the Gambler's Fallacy. Each toss is independent — the probability of Tails stays exactly 1/2 no matter what happened before.

Set	The lie	Correction
3	c	A probability of 0.5 describes the long-run tendency (even chance), not a guarantee about any particular small set of trials — small samples can easily deviate from it.

Part 11 · The Escape Challenge

EXIT CODE: 6 · 9 · 3 · 11 · 25

(Answer: 6) (Answer: 9) (Answer: 3) (Answer: 11) (Answer: 25)

Probability turns "maybe" into a number you can calculate, compare and trust — from a single coin toss to a whole school's worth of survey data. □